

In the lower graph (Fig. 1C), we can observe an increase in  $\Delta ADC$  as dose increases, although the data are not relevant enough because of the few number of patients analyzed.

**Conclusions:** ADC maps can be used not only for treatment assessment, but also for quantification of tumour response voxel by voxel. Even more, the joint use of MRI diffusion data and PET/CT can be useful for delimiting the hypoxic areas, due to glucose consumption enhancement by Pasteur effect. The main weakness of this method is the rigid registration process, and non rigid registration algorithms are needed for the registration of highly distorted images from diffusion studies.

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#### PO-0861

##### Prediction of normal tissue morbidity in radiotherapy of prostate cancer using motion inclusive dose distributions

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**Purpose/Objective:** In radiotherapy (RT) of prostate cancer the key organs at risk (ORs) - the rectum and the bladder - display considerable motion, which may influence the dose/volume parameters predicting for morbidity. In this study we compare motion-inclusive doses to planned doses for the rectum and bladder and explore their associations with prospectively recorded morbidity.

**Materials and Methods:** The study included 38 prostate cancer patients treated with hypo-fractionated image-guided intensity-modulated RT that had an average of nine repeat CT scans acquired during treatment. These scans were registered to the respective treatment planning CT (pCT) followed by a new dose calculation from which motion-inclusive dose distributions were derived. The pCT volumes, the treatment course averaged volumes as well as the planned and motion-inclusive doses were associated with acute and late morbidity (morbidity cut-off:  $\geq$  Grade 2).

**Results:** Acute rectal morbidity (observed in 29% of cases) was significantly associated with both smaller treatment course averaged rectal volumes (population median: 75 vs. 94 cm<sup>3</sup>) and the motion-inclusive volume receiving doses close to the prescription dose (2Gy-equivalent dose of 76 Gy).

**Conclusions:** Variation in rectum and bladder volumes leads to deviations between planned and delivered dose/volume parameters that should be accounted for to improve the ability to predict morbidity following RT.

#### PO-0862

##### Cross-institutional comparison of pharmacokinetic parameters from DCEMRI of cervical cancers: initial results

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**Purpose/Objective:** Biomarkers extracted from functional images may be subject to cross-institutional variations, and are thus in need of standardization. Pharmacokinetic parameters derived from dynamic contrast enhanced (DCE) MRI of cervical cancers have shown a predictive value in identifying patients at risk of relapse following radiotherapy. The aim of the current work was to compare pharmacokinetic parameters obtained from DCEMR images, acquired at different institutions, of patients with locally advanced cervical cancers.

**Materials and Methods:** DCEMRI images from 2 centers have so far been collected. At center 1 (Oslo University Hospital), 78 patients have been included. Here, DCEMRI was performed using Magnevist (Gadopentetate Dimeglumine) as contrast agent and an FSPGR sequence with temporal resolution of 15 s and spatial resolution of 0.8x0.8x5 mm at a 1.5T Signa Horizon LX scanner (GE Medical Systems). At center 2 (University Medical Center, Utrecht), 23 patients have been included. In this case, DCEMRI was performed using Magnevist and a 3D FLASH sequence with 2.4 s temporal resolution and spatial resolution 0.9x0.9x3mm at a 1.5T Gyroscan NT

Intera scanner (Philips Medical Systems). Pharmacokinetic analysis with the 'Brix' model was performed in an identical manner for the two cohorts. The model analysis of the dynamic series was done voxel by voxel in the tumors, providing maps of the  $A_{Brix}$  (amplitude),  $k_{ep}$  and  $k_{el}$  parameters. The median of a given parameter was extracted for each patient, in addition to a relative measure of tumor heterogeneity (difference between 66<sup>th</sup> and 33<sup>rd</sup> percentile, divided by the median). Cohort data for each center was compared using Mann-Whitney tests. P-value<0.05 was considered statistically significant.

**Results:** The cohort-based median values for center 1 versus center 2 was 2.20 vs 3.41 (relative units), 1.59 vs 0.68 (min<sup>-1</sup>) and 0.076 vs 0.080 (min<sup>-1</sup>) for  $A_{Brix}$ ,  $k_{ep}$  and  $k_{el}$ , respectively. For the heterogeneity measure, values obtained were 0.40 vs 0.55, 0.54 vs 0.99 and 1.10 vs 1.70, respectively. Non-significant differences were only found for median values of  $k_{el}$ .

**Conclusions:** Five out of six pharmacokinetic tumor parameters obtained from DCEMRI performed at the two different institutions were significantly different in this preliminary analysis, possibly pointing at differences in MR scanners and acquisition protocols. We aim at including patients from more institutions, at introducing the 'Tofts' pharmacokinetic model and at using reference tissue for normalization. Furthermore, data are to be analyzed in a multivariate setting, accounting for variations in stage, tumor volume and other relevant clinical factors.

#### PO-0863

##### Ultrasound IGRT: Deformable image registration of daily ultrasound images to derive daily CT images

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**Purpose/Objective:** Nowadays, quantitative 3D Ultrasound (US) Image Guided Radiotherapy (IGRT) systems are available which can assess absolute volumetric information on soft tissue. Acquiring daily US images is quick and imposes no extra radiation burden to the patient. For intramodality US systems only the reference CT (planning) image is available. Nevertheless, CT images for every treatment fraction would be useful, e.g. for dose recalculation, and assessing margins. To this end, deformable image registration (DIR) was applied to calculate the deformation field between reference and daily US images. This field was then applied to the reference CT.

**Materials and Methods:** To validate the procedure a deformable phantom was developed, existing of a PMMA box filled with demineralized water, containing two balloons filled with either saline solution or sunflower oil with a variable volume. Four different configurations were imaged with CT as well as US. Deformation fields are computed between several pairs of US images and then applied to the corresponding CT of the first US of the pair (see figure). This reconstructed new, matching CT for the second US is then compared to the real corresponding CT of the second US using the sum of squared differences (SQD) metric. The deformation fields are calculated using an elastic registration algorithm (REGGUL; morphons). The SQD metric was limited to the area where US information was available.